Polyplacophora taxocoene of Ognina and Acitrezza (bay of Catania, Sicily), with some notes on early development of *Lepidochitona monterosatoi* Kaas & Van Belle, 1981

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ABSTRACT The ecology of some shallow water species of Mediterranean Polyplacophora were studied. Seasonal samples, over a period of 5 months (from January to May 1997), were obtained in two differently exposed sites of the Bay of Catania (East Sicily). Seven species of Polyplacophora were recorded: two of them, *Lepidochitona monterosatoi* Kaas & Van Belle, 1981 and *Chiton phaseolinus* Monterosato, 1879, are particularly interesting because of their rarity and lack of knowledge about their ecology and biology. Here we describe for the first time the earliest stages of the life cycle (from egg to 20 days after spawning) of *L. monterosatoi* and report details of its brooding behavior. New data on seasonal changes in taxocoene structure and displacement are also reported.

RIASSUNTO Il lavoro tratta dell'ecologia di alcune specie mediterranee di poliplacofori presenti in due località della costa nord di Catania (Sicilia orientale), il sito riparato costituito dal porto di Ognina e la più esposta insenatura di Acitrezza. Campionamenti mensili sono stati condotti nell'arco di 5 mesi (dal Gennaio al Maggio 1997), durante i quali sono state rinvenute sette specie di poliplacofori: due di queste, *Lepidochitona monterosatoi* Kaas & Van Belle, 1981 e *Chiton phaseolinus* Monterosato, 1879, risultano di maggior interesse, per la loro rarità e per l'assoluta mancanza di notizie sulla loro ecologia e biologia. Per la prima volta sono descritte le fasi iniziali del ciclo vitale di *L. monterosatoi* (dall'uovo fino a 20 giorni dopo la schiusa), che è risultata particolarmente degna di nota per il suo habitus riproduttivo. In un primo periodo le uova fecondate vengono incubate dalla femmina nella cavità del mantello: qui le trocofore fuoriuscite dalle uova vengono trattenute per circa un giorno e solo in un secondo momento rilasciate nell'ambiente esterno, dove nuotando liberamente, trascorrono un breve periodo nel plancton per poi definitivamente guadagnare la condizione bentonica, insediandosi su alghe calcaree del genere *Lithophillum*. Sono forniti, ancora, dati relativi ai cambiamenti della struttura e distribuzione del popolamento a chitoni delle aree indagate durante le stagioni in cui sono stati condotti i campionamenti, che mostrano significativi cambiamenti nella composizione quali-quantitativa delle varie specie presenti.

KEY WORDS: Polyplacophora, taxocoene, shallow bottoms, Sicily, *Lepidochitona*, brooding, ecology.

INTRODUCTION

Monthly samples were obtained from January to May 1997 in two sites of the Bay of Catania (East Sicily): the sheltered port of Ognina and the more exposed inlet of Acitrezza. The substrate consisted mainly of the red alga *Lithophyllum incrustans* Philippi, where seven species of Polyplacophora were found (**Pl. I, fig. 3**): *Ischnochiton rissoi* (Payraudeau, 1826), *Callochiton septemvalvis* (Montagu, 1803), *Lepidochitona caprearum* (Scacchi, 1836), *Lepidochitona monterosatoi* Kaas & Van Belle, 1981, *Chiton olivaceus* Spengler, 1797, *Chiton phaseolinus* Monterosato, 1879, *Acanthochitona fascicularis* (Linné, 1767). Of these species, *C. phaseolinus* (**Pl. I, figs 1-2**) and *L. monterosatoi* (Pl. I, fig. 4) are particularly interesting because the first was only recently rediscovered (Gaglini, 1989) and the second was quite recently described: consequently their biology and ecology are unknown. Furthermore, the only work specifically on the biology of a Mediterranean species is that of Kowalevsky (1883) on *Chiton polii* Philippi, 1836 [=*L. caprearum* (Scacchi, 1836)].

MATERIALS AND METHODS

Samples were obtained by scraping the rocky surface with a cutting blade in a 2x2 m frame. Samples were collected monthly, from January to May 1997. The material was observed with a stereo-microscope for measurement and identification of specimens. For observation of living chitons, some specimens were placed in a 100 l aquarium (temperature 17-26°C, salinity 36.9-39.7‰, pH 8.5). The chitons were kept separate in the aquarium in plastic boxes with holes drilled to allow exchange of seawater (20x10x10 cm).

RESULTS

Lepidochitona monterosatoi was the most frequent/abundant chiton species in both sites (**fig. 9-10**). Throughout the sampling period, *C. phaseolinus* was only found in the sheltered site of Ognina, where it ranked second in abundance after *L. monterosatoi*. On the other hand, *L. caprearum* was only found at Acitrezza and only in winter. *A. fascicularis* was the third most common species. The

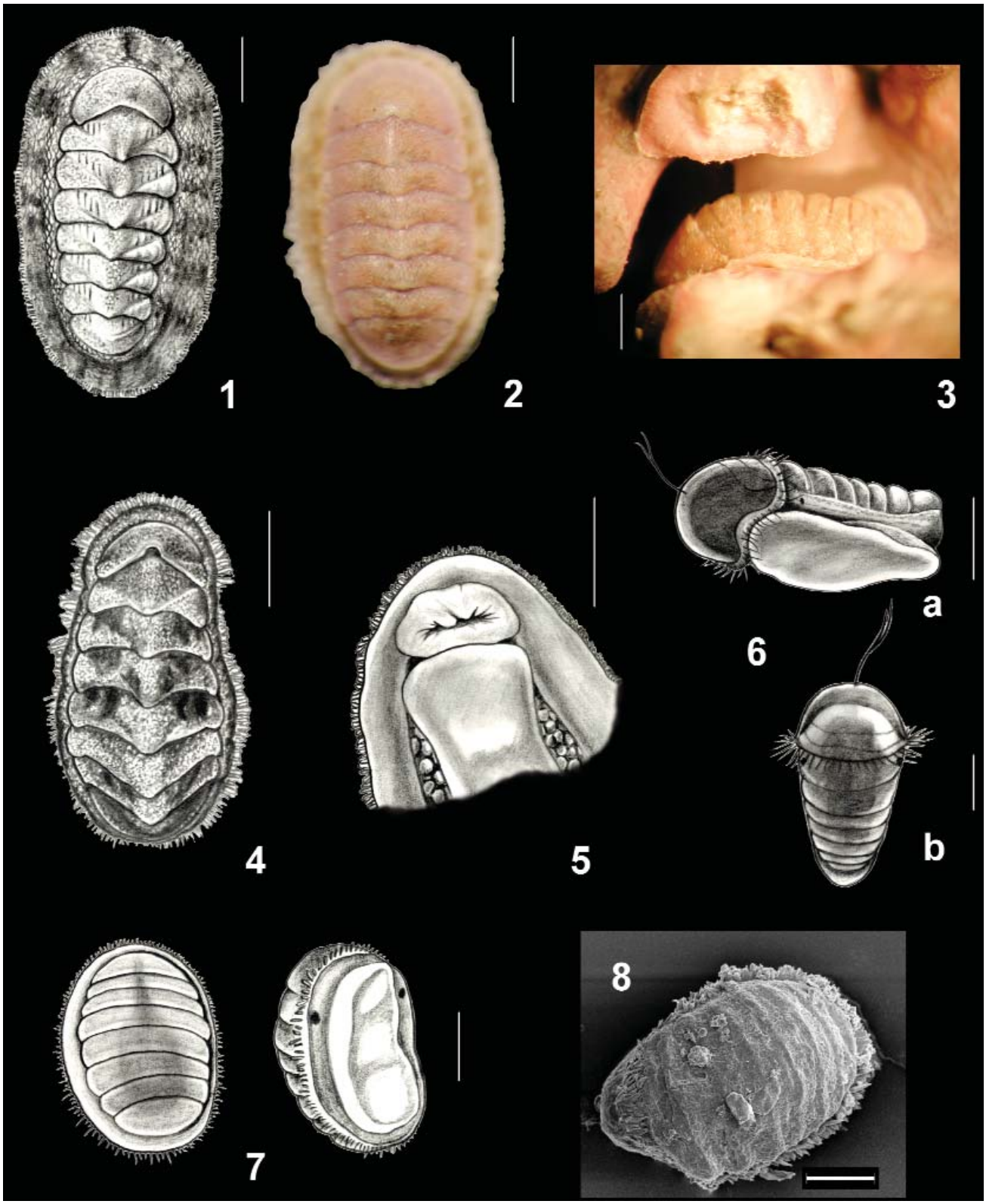

Plate I: Figs 1-3. *Chiton phaseolinus*. 1, 2: drawing and photograph of a specimen from Ognina (scale bar 2 mm); 3: specimen on substrate (scale bar 2 mm); **Figs 4-8.** *Lepidochitona monterosatoi*. 4: drawing of an adult specimen from Ognina (scale bar 2 mm); 5: drawing of brooder with eggs in mantle cavity (scale bar 2 mm); 6a-b: drawing of trochophora (scale bar 0.1 mm); 7: drawing of metamorphosed juveniles (scale bar 0.1mm); 8: SEM image of a juvenile (scale bar 30 µ).

Tav. I: Figg. 1-3. *Chiton phaseolinus*. 1, 2: disegno e fotografia di un esemplare da Ognina (scala di riferimento 2 mm); 3: un individuo sul substrato (scala di riferimento 2 mm); **Figg. 4-8**. *Lepidochitona monterosatoi*. 4: disegno di un individuo adulto da Ognina (scala di riferimento 2 mm); 5: disegno di un individuo con uova incubate nella cavità del mantello (scala di riferimento 2 mm); 6a-b: disegno di una trocofora (scala di riferimento 0.1 mm); 7: disegno di un individuo giovanile appena metamorfosato (scala di riferimento 0.1 mm); 8: fotografia al SEM di un individuo giovanile (scala di riferimento 30 µ).

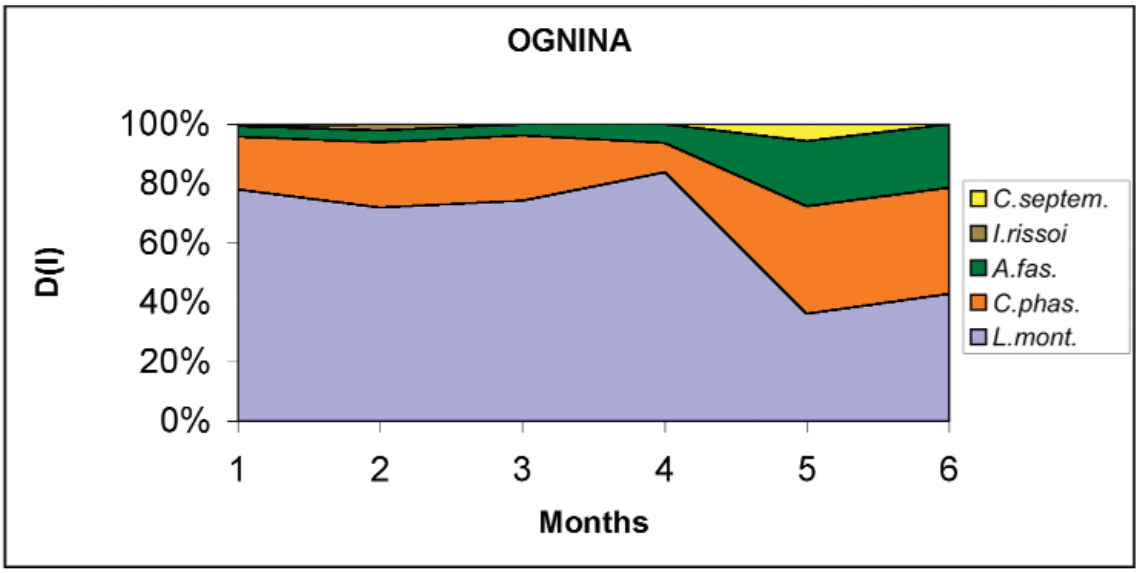

Fig. 9

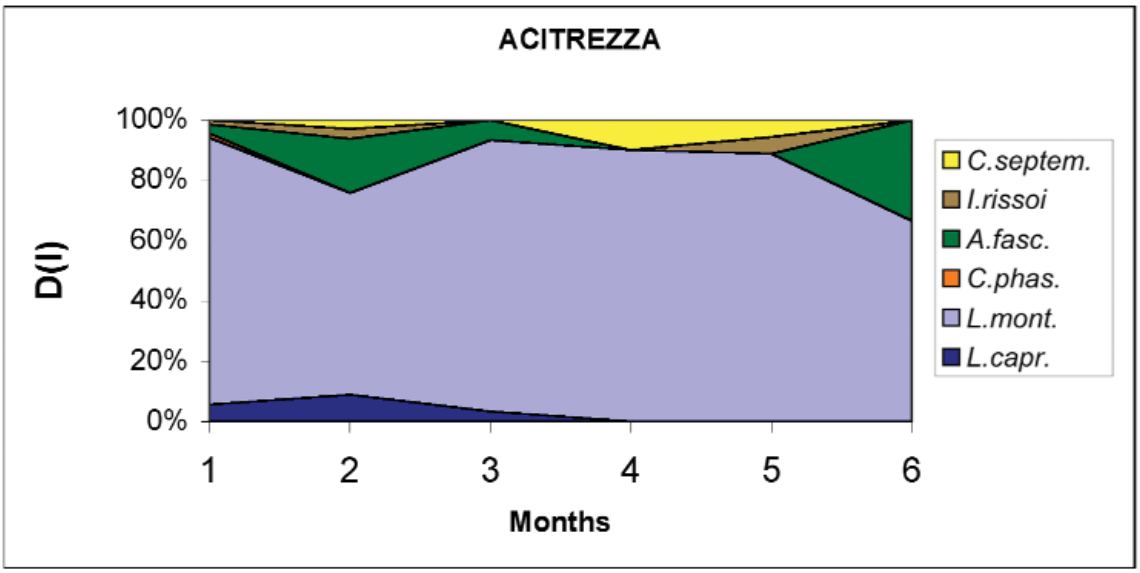

Fig. 10

Figs 9-10. Abundance of chitons in the two sites.
Figg. 9-10. Grafico dell'abbondanza percentuale delle varie specie di chitoni nei due siti.

other species were only rare or occasional. Analysis of population structure of the three main species revealed a discontinuity in the frequency distributions of size classes; this made it possible to distinguish the juvenile cohort from the adult one.

In *L. monterosatoi*, the pattern of abundance was similar in the two stations, with decreasing values from winter to summer. At Ognina, juveniles were more abundant over the entire sampling period, whereas at Acitrezza they were abundant only in the early spring (**figs 13-14**).

The pattern of abundance of *A. fascicularis* was opposite in the two stations: increasing from winter to summer, at Ognina and decreasing at Acitrezza. In both stations, juveniles greatly outnumbered adults in winter and early spring, whereas the adults predominated in late spring to summer (**figs 11-12**).

The rare species *C. phaseolinus* was abundant at Ognina, decreasing in numbers from winter to summer. Juveniles were dominant in winter and early spring, whereas adults were most common in late spring to summer (**fig. 15**).

Early development of *L. monterosatoi*

In February 1997, 8/21 specimens of *L. monterosatoi* collected (38% of the whole material of this species) were

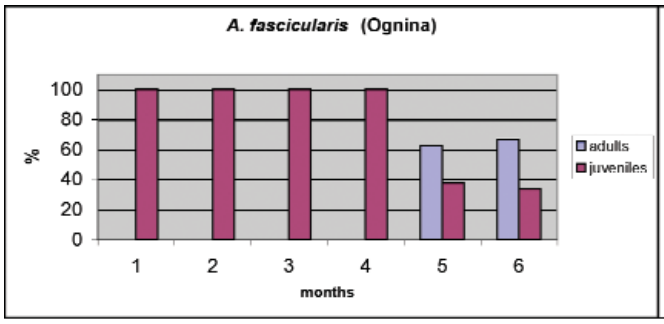

Fig. 11

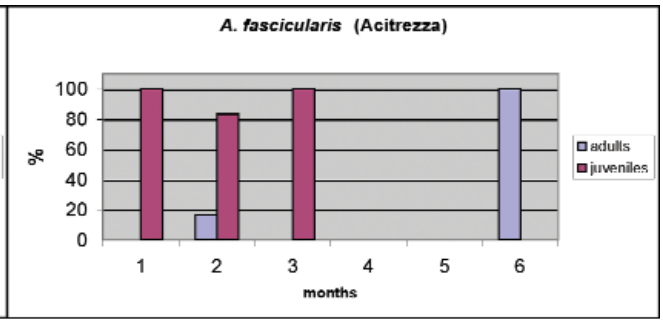

Fig. 12

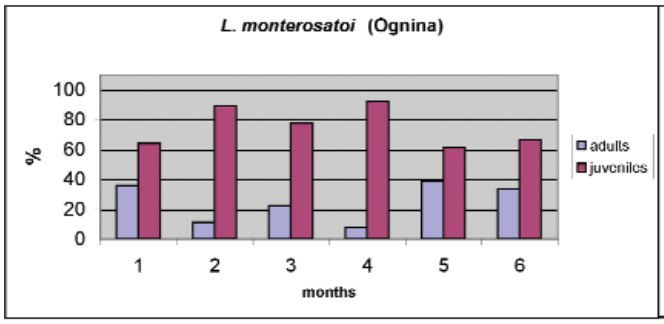

Fig. 13

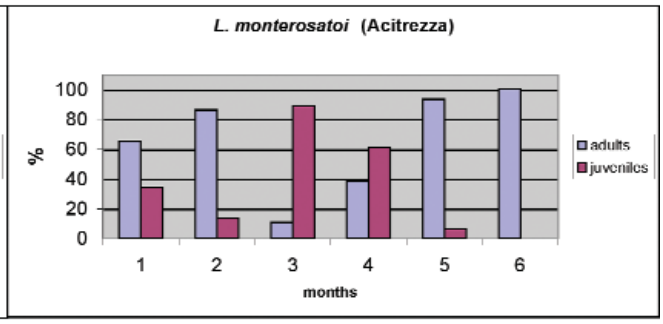

Fig. 14

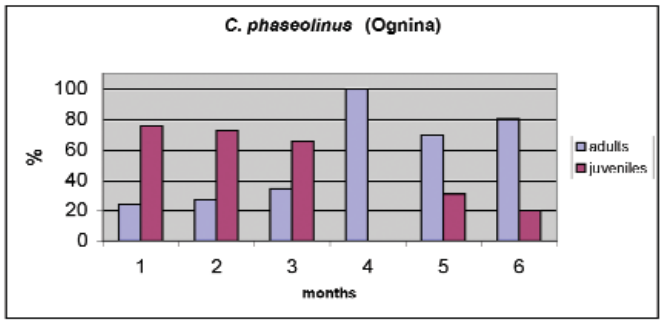

Fig. 15

Figs 11-12. Percentage ratios of adults-juveniles of *A. fascicularis* in the two sites.
Figs 13-14. Percentage ratios of adults-juveniles of *L. monterosatoi* in the two sites.
Fig. 15. Percentage ratios of adults-juveniles of *C. phaseolinus* at Ognina.

Figg. 11-12. Grafico della percentuale tra adulti e giovanili di *A. fascicularis* nei due siti.
Figg. 13-14. Grafico della percentuale tra adulti e giovanili di *L. monterosatoi* nei due siti.
Fig. 15. Grafico della percentuale tra adulti e giovanili di *C. phaseolinus* ad Ognina.

brooding embryos in the pallial groove. The brood consisted either of unhatched embryos, held together in a gelatinous string, or hatched trochophore larvae (**Pl. I, fig. 5**). There were about 100-120 embryos per specimen, each about 0.28 mm in diameter, light brownish in colour with a darker middle line. They were brooded, together with all other embryos, on each side of the foot.

About 5-7 days after collection, the eggs changed from brownish to green and then suddenly hatched. The trochophore larvae were 0.43 mm in length and green in colour, with two lateral post-trochal eyes and a beating prototroch (**Pl. I, figs 6a-b**): they were retained for 24 h in the mantle cavity of the parent. When released, they became free swimming in the water. As observed in other species, this could be an artifact of laboratory culture, because they crawl away in the field (Eernisse pers. com.).

About 24 h after release, the free trochophores larvaes settled on the bottom of their plastic box placed in the aquarium. At this stage, they only had seven faint folds in the dorsal region and an enlarged cephalic part, with the

eyes just posterior to it. After settling, metamorphosis occurred in about 48 h. Juveniles (**Pl. I, fig. 7**) did not increase in size in the days following settling. Within a few days they had 8 valves (**Pl. I, fig. 8**) but all died within 20 days of metamorphosis.

DISCUSSION

Very few specific ecological or reproductive studies have been carried out on Mediterranean Polyplacophora, apart from notes on the habitat of certain species (Baschieri, 1994; Basso, 1995; Bedulli et al., 1987; Biondi *et al.*, 1983; Scuderi & Dell'Angelo, 1995; Strack, 1988, 1990). This study is among the first to describe the reproduction and population ecology of chitons in the Mediterranean Sea.

Rather abundant collections of the normally rare *L. monterosatoi* and the rare *C. phaseolinus* allowed preliminary analysis of the population dynamics and structure of these species. Juveniles were more abundant in winter (spawning period) and adults were more common in late spring to summer. In the two very shallow stations, abundances decreased from winter to summer, probably due to high mortality rates in the juvenile stages.

No data is available on the reproductive strategies of *C. phaseolinus*: the reproductive period of this species may be in the period of the year (June-December) not considered in the present study.

Although the genus *Lepidochitona* has quite a few brooding species, only *L. caprearum* has been reported as a brooder in the Mediterranean (Kowalevsky, 1883). The early stages of development of *L. monterosatoi* are described here for the first time. This species also broods embryos in the pallial groove, releasing larvae into the water after hatching. Our observations on *L. monterosatoi* agree with those of Eernisse (1988), namely that small adult size and large egg size are typical traits of brooders. Further specific analysis of *L. monterosatoi* is needed to determine whether it is a cross-fertilizing or self-fertilizing species. Most Polyplacophora species, however, are gonochoric.

Concerning the ontogeny of the plates, chiton species appear to vary somewhat in their sequence of formation: in some species, such as *Mopalia ciliata* (Thorpe, 1962), valve I is the first to appear, whereas in others, such as *M. lignosa* (Gould, 1846), the cephalic plate only appears after formation of the other valves (Watanabe & Cox, 1975). SEM images of metamorphosed juveniles of *L. monterosatoi* a few days after settling revealed that they already had 8 valves.

With regard to evolutionary pressure leading to brooding-strategy, our observations of *L. monterosatoi* agreed with those of Eernisse (1988), who concluded that free-spawned chiton larvae were unlikely to settle near their parents, whereas brooded larvae were more likely to do so. In fact, the presence of this rare species, so common in restricted environments such as those studied by us, could be related to a greater tolerance of freshwater than other chiton species; indeed freshwater input directly affects the physiology of chitons, as it does in other molluscs, such as the Rissoidae (Warén, 1996), and polychaetes (Mollica, 1998), or has an indirect effect due to its influence on the growth of red algae.

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